Remarks

In the outstanding Office Action, the Examiner has rejected claims 1-22 and 25 under 35 U.S.C. § 103(a) as being unpatentable over Mravic et al., United States Patent No. 6,158,351, (hereinafter "Mravic") in view of Reese et al., United States Patent No. 5,656,791, (hereinafter "Reese") and the Goetzel article (hereinafter "Goetzel"). The Examiner has rejected claims 23-24, 29-41 and 51-58 under 35 U.S.C. § 103(a) as being unpatentable over Mravic in view of Reese and further in view of Kock et al., United States Patent No. 4,498,395, (hereinafter "Kock") and Oltrogge, United States Patent No. 5,279,787, (hereinafter "Oltrogge").

Rejections Under 35 U.S.C. 103(a):

Claims 1-3 and 5-22:

The Examiner has rejected claims 1-3 and 5-22 under 35 U.S.C. 103(a) as being obvious. As amended, independent claims 1 and 9 read as follows:

> 1. A liner for a shaped charge comprising:
> a mixture of powdered tungsten and powdered metal binder wherein said powdered tungsten comprises from 92 percent by weight of said mixture to 97 percent by weight of said mixture, and wherein said powdered metal binder comprises from 8 percent by weight of said mixture to 3 percent by weight of said mixture, said mixture compressively formed into a liner body shape.
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> 9. A shaped charge comprising:
> a housing;
> a quantity of explosive inserted into said housing; and
> a liner inserted into said housing so that said quantity of explosive is positioned between said liner

and said housing, said liner formed from a mixture of powdered tungsten and powdered metal binder, wherein said powdered tungsten comprises from 92 percent by weight of said mixture to 97 percent by weight of said mixture, and wherein said powdered metal binder comprises from 8 percent by weight of said mixture to 3 percent by weight of said mixture, said mixture compressively formed into a liner body shape.

The Examiner explained his rejection of claims 1-3 and 5-22 as follows:

> Claims 1, 2, 3 and 5-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mravic et al. in view of Reese et al. '791 and Goetzel. Mravic et al. disclose the invention substantially as claimed. Mravic et al. disclose ashaped charge liner (see last sentence of abstract) formed by the method comprising:
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> providing a high density constituent of a material selected from a group comprising tungsten (col. 2, line 18);
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> providing a low density constituent (col. 2, lines 22-24);
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> mixing the high and low density constituents to form a mixture (col. 5, lines 60 to col. 6, line 23) ; and
>
> forming the mixture into a shaped charge liner (see last sentence of Abstact [sic]).
>
> Mravic et al. further disclose wherein the low density constituent comprises tin, zinc, iron, nickel, cobalt and copper (col. 2, lines 22-23).
>
> Mravic et al. further disclose wherein the tungsten constituent is present in a preferred range of from about 70% to about 90% (col. 4, lines 13-15), but discloses Examples that contain higher levels of the high density constituent, up to about 96% (see Fig. 1).
>
> . . .
>
> The overlap of claimed range of material composition establishes a prima facie case of obviousness (See MPEP 2131.03).

As noted in more detail below, Applicant respectfully disagrees with the Examiner's characterizations of the teachings of the

Mravic reference, in particular with respect to the proportion of tungsten in the metal composite. Further, Mravic clearly teaches away from any metal composite comprising anything close to 90% tungsten by weight.

The Mravic Reference does not disclose a composite having 90% tungsten by weight:

United States Patent Number 6,158,351 to Mravic et al. ("Mravic") discloses a "ferromagnetic bullet" comprising a compacted composite having a high-density constituent and a low-density constituent. The high-density constituent is disclosed as preferably being ferrotungsten, and is present in an amount sufficient to impart the article with ferromagnetic properties. The low-density constituent is disclosed as being either a metal alloy or a polymer. Although the proportions of the high density and low density constituents vary from one embodiment to another, Mravic teaches that it is essential that the article both have approximately the same density as lead in order to exhibit proper ballistic behavior and exhibit ferromagnetic properties in order to facilitate the article's separation from surrounding soil after use.

The Examiner asserts that Mravic discloses that "the tungsten constituent is present in a preferred range of from about 70% to about 90% (col. 4, lines 13-15), but discloses Examples that contain higher levels of the high density constituent, up to about

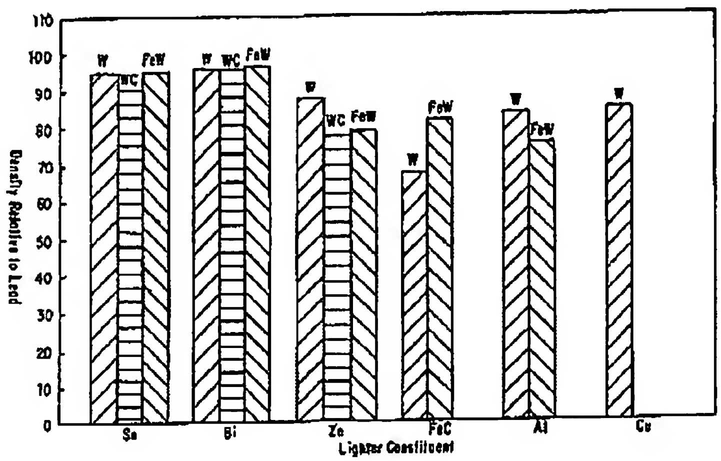
96% (see Fig. 1)." Applicant respectfully disagrees with the Examiner's position on both of these points. The cited portion of Mravic reads as follows:

> Suitable ferromagnetic constituents for the high density first component include ferrotungsten and cemented tungsten carbide alloys having a ferromagnetic addition. **Ferrotungsten is generally understood to be a tungsten base alloy that includes iron having a tungsten content by weight of from about 70% to about 85%.** Preferably, the carbon content of the ferrotungsten is less than about 0.6%. In this patent application, any tungsten base alloy containing iron that exhibits ferromagnetism is included.
>
> In the projectile, **the ferrotungsten is present in a weight percent above about 50% and preferably from about 70% to 90% is preferred.** (Emphasis added)

Accordingly, Mravic teaches that either <u>ferrotungsten</u> or <u>tungsten carbide</u> may be employed as the high-density constituent of a ferromagnetic metal composite in a proportion of up to 90% by weight. Further, Mravic teaches that the proportion of tungsten in ferrotungsten ranges from 70% to 85% by weight. Accordingly, Mravic teaches that the proportion of tungsten in the composite may range as high as <u>85% of</u> 90% by weight of the composite. In other words, the proportion of tungsten may range as high as 0.85 x 0.90, or <u>76.5%</u> of the composite by weight. Accordingly, the cited text of Mravic clearly does not disclose <u>tungsten</u> in an amount from about 70% to about 90% by weight.

<u>The Mravic Reference does not disclose a composite having 96% tungsten by weight:</u>

With respect to the Examiner's assertion that Figure 1 of Mravic discloses "Examples that contain higher levels of the high density constituent, up to about 96%," Applicant again must respectfully disagree with the Examiner's assertion. Figure 1 of Mravic appears as shown to the right. The written description of Mravic describes Figure 1 as "a bar graph of densities of powder composites." From the written description of Figure 1, it is clear that this is a graph of the measured densities of certain metal matrix composites manufactured in accordance with the teachings of the Mravic reference. This figure is described within the written description of Mravic from column 5, line 60 through column 6, line 5, which read as follows:



> FIG. 1 shows the **densities attained** with metal matrix composites made of tungsten powder, tungsten carbide powder or ferrotungsten powder blended with powder of either tin, bismuth, zinc, iron (with 3% carbon), aluminum, or copper. The proportions were such that they would have the density of lead if there was no porosity after sintering. The powders were cold compacted into half-inch diameter cylinders using pressures of 100 ksi. They were then sintered for two hours at appropriate temperatures, having been sealed in stainless steel bags. The sintering temperatures were (in degrees Celsius) 180, 251, 350, 900, 565, 900 respectively. (Emphasis added).

The vertical axis of Figure 1 is labeled "Density Relative to Lead" on a scale of 0 to 110 (see above). Although Figure 1 and its written description do not explicitly state that the vertical axis is a percent scale, Applicant submits that this is the only reasonable manner of interpreting the vertical axis of Figure 1. Accordingly, a value of 100 on the vertical axis would represent 100% of the density of lead, the value 50 would represent 50% of the density of lead, etc. As noted, Figure 1 reflects the measured density of manufactured composites as compared to the density of lead. The Examiner appears to be reading Figure 1 as if the vertical bars were intended to represent the weight of the heavy metal as a proportion of the weight of the composite. A review of Figure 1 and its description reflects that Figure 1 does not reflect this information. Applicant notes that tungsten is approximately 70% denser than lead. As an example, a metal composite containing 96% tungsten and 4% tin would far exceed the density of lead, as tin is approximately 64% of the density of lead. Accordingly, the portion of Figure 1 showing a tin-tungsten composite having a density of between 90% and 100% of the density of lead cannot be reasonably interpreted to teach a composite incorporating over 90% tungsten by weight. Accordingly, there is no basis for the Examiner's statement that Mravic discloses "Examples that contain higher levels of the high density constituent, up to about 96% (see Fig. 1)."

In light of the above, Applicant respectfully submits that there is no support whatsoever within Mravic for the Examiner's statement that "Mravic et al. further disclose wherein the tungsten constituent is present in a preferred range of from about 70% to about 90% (col. 4, lines 13-15)" or the Examiner's statement that Mravic "discloses Examples that contain higher levels of the high density constituent, up to about 96% (see Fig. 1)." As noted above, the cited portions of Mravic teach an article comprising no more than approximately 77% tungsten by weight. Accordingly, Mravic does not teach or suggest a shaped-charge liner comprising 92% to 97% tungsten by weight.

Mravic teaches away from a mixture comprising 92%-97% tungsten by weight

Not only does Mravic fail to teach a metal composite having any proportion of tungsten in excess of approximately 77%, Mravic explicitly teaches away from any such composition. The Mravic reference is titled "Ferromagnetic Bullet." As noted above, Mravic teaches that the article disclosed therein is ferromagnetic (i.e., responsive to magnetic fields) and has a density close to that of lead. The ferromagnetic qualities of the article are necessary in order to retrieve the article, or portions thereof, from soil after use. The particular density is preferred in order to impart ballistic qualities similar to that of a lead projectile. Both of

these attributes are described repeatedly as being necessary to the invention (see, e.g., col. 3 of the written description).

Mravic teaches that a mixture including 92%-97% tungsten would not exhibit the proper density

As discussed briefly above, the density of tungsten is approximately 170% of the density of lead. Accordingly, an article comprising in excess of 90% tungsten by weight mixed with another metal would have a density far in excess of the density of lead. Such an article would exhibit none of the ballistic characteristics of lead. As suggested in Mravic, the proper composition would need to be less than 77% tungsten by weight in order to exhibit the proper ballistic behavior. Thus, Mravic would lead one of skill in the art away from constructing an article having any composition of tungsten in excess of approximately 77% by weight.

Mravic teaches that a mixture of 92%-97% tungsten would not exhibit the proper ferromagnetism

With respect to the ferromagnetic properties of the composition, the Examiner has not made any showing that the mixture of 92% tungsten within a metal binder could be made to exhibit the ferromagnetic properties required by Mravic. To the extent that such a mixture could be made, Mravic does not provide any guidance as to how such a mixture might be constituted. Mravic discloses a composition containing up to 90% ferrotungsten, which itself

includes at least 15% iron. As an alternate embodiment, Mravic discloses that iron may be employed as the binder, in which case at least 10% by weight of iron be included in the mixture. Thus, Mravic teaches that the material contain at least 10% non-tungsten materials in order to exhibit the required ferromagnetic properties. Thus, Mravic would lead one of skill in the art away from constructing an article having any composition having less than 10% iron by weight.

Claim 4:

The Examiner rejected claim 4 under 35 U.S.C. 103(a) as being obvious. Claim 4 reads as follows:

> 4. The liner for a shaped charge of claim 2, wherein said lubricant comprises oil.

The Examiner explained the rejection of claim 4 as follows:

> Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mravic et al in view of Reese et al. '791 and Goetzel.
>
> Mravic et al. in view of Reese et al. '791 disclose the invention substantially as claimed (see paragraph 3 above). However, Mravic et al. in view of Reese et al. '791 do not disclose wherein a lubricant is added to the mixture.
>
> Goetzel teaches that oil is an equivalent to graphite in the same field of endeavor for the purpose of adding lubricant to the mixture. It would have been obvious to one having ordinary skill in the art at the time of the invention to add oil in place of graphite in the invention of Mravic et al. as taught by Goetzel in order to provide lubrication.

Applicant respectfully submits that claim 4 is allowable for the same reasons as claim 1 from which it depends.

Claims 23, 24, 29-41 and 51-60:

The Examiner rejected claim 23, 24, 29-41 and 51-60 under 35 U.S.C. 103(a) as being obvious. Independent claim 23 reads as follows:

> 23. A liner for a shaped charge comprising:
> a mixture of powdered tungsten and powdered metal binder including approximately 92 to 99 percent by weight of the tungsten and approximately 8 to 1 percent by weight of the binder, the binder including lead and a metal selected from the group comprising tantalum, molybdenum and combinations thereof, the mixture compressively formed into a substantially conically shaped rigid body.
>
> 29. A liner for a shaped charge comprising:
> a mixture of powdered tungsten and powdered metal binder including approximately 92 to 99 percent by weight of the tungsten and approximately 8 to 1 percent by weight of the binder, the binder comprising lead and tantalum, the mixture compressively formed into a substantially conically shaped rigid body.

The Examiner explained his rejection of claims 23, 24, 29-41 and 51-60 as follows:

> Claims 23, 24 and 29-34, 35-38, 39-41, 51-57 and 58-60 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mravic et al. in view of Reese et al. '791 and further in view of Kock et al and Oltrogge.
>
> Mravic et al. in view of Reese et al. '791 disclose the invention substantially as claimed (see paragraph 3 above). However, Mravic et al. in view of Reese et al. '791 do not disclose wherein the binder includes lead and a constituent selected from Mo and Ta and combinations thereof.

> Mravic et al. discloses his selection of materials as an alternative to lead containing materials in order to avoid applications where lead is an undesirable contaminant (col. 1, line 18 to col. 2, line 14), but not specifically disclose a Pb binder embodiment.
>
> Reese et al. '791 teaches that Pb is a matix [sic] material that can be used in forming high density/low density composite projectiles where Pb contamination is not undesirable.
>
> It would have been obvious to one having ordinary skill to substitute Pb for the low density constituent of Mravic et al. as taught by Reese et al. '791, since Reese et al '791 teaches Pb to be an equivalent to the binder metals of Mravic et al.
>
> Reese et al. '791 is silent as to the mixture further comprising Mo, but discloses Ni and Co as additional binder materials.
>
> Kock et al. teaches that Mo is an equivalent material to Ni and Co in the same field of endeavor.
>
> Thus, it would have been obvious to substitute molybdenum for cobalt or nickel in the invention of Mravic et al. in view of Reese et al. '791, since the substitution is known as taught Kock et al
>
> Oltrogge teaches Ta is a high density material that can be used as an equivalent to W in the same field of endeavor (col. 5, line 5 to col. 6, line 32).
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> It would have been obvious to one having ordinary skill to substitute Ta in part for the tungsten material of Mravic et al. in view of Reese et al. '791, since Oltrogge teaches the equivalence of these materials. The Examiner notes that no weight is given to the characterization of Ta as a binder material

Applicant respectfully submits that the Examiner's rejections of 23, 24, 29-41 and 51-60 are improper. The Examiner's rejections of these claims are based on the Examiner's identification of discrete disclosures within disparate references identifying certain

metallic elements as being potentially useful for similar purposes. Based on these discrete disclosures, the Examiner arrives at certain conclusions as to equivalence between some very different metals, as described in further detail below.

Reese et al '791 does not teach that lead is equivalent to the binder metals of Mravic et al.

The Examiner asserts that "Reese et al. '791 is silent as to the mixture further comprising Mo, but discloses Ni and Co as additional binder materials." The Examiner has not identified where this teaching is found, but Applicant presumes the Examiner is referring to the disclosure within the Abstract and claims of Reese, which read, in part, as follows:

> "The powdered metal binder preferably comprises a malleable, ductile metal such as lead, bismuth, tin, zinc, silver, antimony, cobalt, nickel or uranium." (Reese Abstract)
>
> "...said binder comprising a malleable, ductile metal selected from the group consisting of lead, bismuth, silver, gold, tin, uranium, antimony, zinc, cobalt and nickel,..." (claim 1)

The Examiner appears to be employing Reese for the proposition that any of lead, tin, antimony, bismuth, zinc, gold, silver, copper, nickel and uranium could potentially be used as a binder metal within the context of the disclosure. Applicant respectfully submits that Reese does not teach that these metals are equivalent to one another in any broader sense. These metals are certainly not, for example, equivalent in terms of mechanical properties.

Nickel, for example, is often employed to construct high-temperature aircraft turbines. Applicant is aware of no aircraft manufacturer constructing aircraft turbines from lead. A review of Reese reveals that Reese teaches merely that one of these metals, including nickel and cobalt, may be suitable binders within certain embodiments of the specific application disclosed therein.

Kock does not teach that molybdenum is "an equivalent material" to nickel or cobalt

Applicant has not identified within Kock any discussion of the use of molybdenum within the context of a shaped charge liner. Accordingly, it is not clear what the Examiner means when he asserts that the disclosure of Kock relates to the "same field of endeavor" as the claimed invention. Even if one were to assume, for the purposes of argument, that Kock can be considered in "the same field of endeavor" as Applicant's invention, Kock does not teach that molybdenum is "an equivalent material" to either nickel or cobalt. Kock teaches merely that nickel, cobalt or molybdenum may be used to manufacture the material disclosed therein. Kock does not provide any guidance as to the relative performance of materials comprising nickel, cobalt or molybdenum. In particular Kock provides no guidance as to whether the performance of a shaped charge liner comprising molybdenum might exhibit superior, identical or inferior performance to a shaped charge liner comprising nickel or cobalt. Accordingly, Applicant respectfully

submits that the Examiner's position that Kock teaches that molybdenum is equivalent to nickel and cobalt cannot be supported.

Oltrogge does not teach that tantalum is an equivalent to tungsten

The Examiner asserts that Oltrogge teaches the equivalence of tungsten and tantalum in the "same field of endeavor". Applicant has not found within Otrogge any discussion the use of either tungsten or tantalum within the context of a shaped charge liner. Accordingly, it is not clear what the Examiner means when he asserts that Oltrogge is discussing the "same field of endeavor" as the claimed invention.

Even if one were to assume, for the purposes of argument, that Oltrogge can be considered in "the same field of endeavor" as Applicant's invention, a review of the rejected claims will reveal that the rejected claims recite tantalum as a component of the binder material, and not as a component of the high-density material. Based on the Examiner's position that tantalum and tungsten are interchangeable, the Examiner appears to be reading the rejected claims as if they recited a shaped charge liner made of a material comprising 92-98% tungsten in combination with 2%-8% "tungsten equivalent." In other words, the Examiner appears to be reading the claims as if they recited a shaped charge liner essentially made of 100% tungsten. If this is indeed the Examiner's position, then the Examiner has a burden to identify a

disclosure of a shaped charge liner comprising 100% tungsten in order to establish a prima facie case of obviousness. The Examiner has not produced such a disclosure. Accordingly, Applicant respectfully submits that a prima facie case of obviousness cannot be established in light of the cited art *even if* the Examiner were to establish that tantalum is, for all practical purposes, equivalent to tungsten.

Nevertheless, Oltrogge does not teach that tantalum is "equivalent" to tungsten. Oltrogge discloses a group of metal mixtures formulated to have particular densities. In at least two embodiments, Oltrogge discloses certain mixtures of tantalum and other metals in certain proportions. In alternate embodiments, Oltrogge discloses mixtures of certain metals with tungsten. Oltrogge discloses that other dense metals such as iridium, osmium, rhenium and gold can be substituted in place of tungsten or tantalum. As discussed above, the disclosure that one of two different materials can be employed for a given purpose does not establish that the two materials are "equivalent".

Under the logic employed by the Examiner, each of the transition metals is apparently considered equivalent to every other transition metal. According to Reese, discussed above, <u>gold</u> can be used as a binder metal. According to Kock, <u>rhenium</u> may be used as a binder metal. According to Oltrogge, gold, rhenium, tantalum or tungsten may be used as a high-density metal. Under

the Examiner's logic, as applied to the above references, both tungsten and tantalum would be considered mechanically equivalent, for example, to gold. Under this logic, Applicant's claimed invention would apparently be obvious in light of pure gold, as gold is apparently considered equivalent to tungsten and to all of the disclosed binder materials. Does the Examiner consider <u>mercury</u> reasonably mechanically equivalent to <u>uranium</u>? Applicant respectfully submits that these metals <u>cannot</u> be reasonably considered mechanical equivalents. Accordingly, Applicant respectfully submits that the Examiner's position that the listed transition metals are all essentially equivalent to one another cannot be supported.

<u>Claim 25:</u>

The Examiner rejected claim 25 under 35 U.S.C. 103(a) as being obvious. Claim 25 reads as follows:

> 25. The liner as recited in claim 23 further comprising oil intermixed with said tungsten and said powdered metal binder to decrease oxidation.

The Examiner explained the rejection of claim 25 as follows:

> Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mravic et al. in view of Reese et al. '791 and further in view of Goetzel,
>
> Mravic et al. in view of Reese et al. '791 disclose the invention substantially as claimed (see paragraph 5 above). However, Mravic et al. in view of Reese et al. '791 do not disclose wherein and oil lubricant is added to the mixture.

> Goetzel teaches that oil is an equivalent to graphite in the same field of endeavor for the purpose of adding lubricant to the mixture. It would have been obvious to one having ordinary skill in the art at the time of the invention to add oil in place of graphite in the invention of Mravic et al. as taught by Goetzel in order to provide lubrication.

Applicant respectfully submits that claim 25 is allowable for the same reasons as claim 23 from which it depends, the patentability of which has been discussed in detail above.

Fee Statement

Other than the enclosed form PTO-2038, Applicant believes no fees are due in conjunction with the filing of this Response. If additional fees are due, or if overpayment has been made, however, please debit or credit our deposit account, Account No. 03-1130.

Conclusion

In light of the foregoing amendments and remarks, Applicant respectfully requests that the Examiner withdraw the rejection of the pending claims under 35 U.S.C. 103(a). The Examiner is respectfully requested to call the undersigned for any reason which would advance this case to issuance.

Dated this 21st day of November, 2005.

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